Fte®
maximal

ETWF 310

USER'S MANUAL

NOTE: This user's guide is adapted to software version v.1.26 of ETWF 310 dated 25/11/2011.
For future software updates, you can download the user's guide from the following website: http://www.ftemaximal.com/

Chapter 1. Installation.

1.1. Safety Measures

1.- Never place the device next to hot sources.
2.- Never undergo the device to temperatures that exceed its level of operation.
3.- Never expose the device to leakings nor spatterings.
4.- Never place objects that contain liquids over the device.
5.- Respect the ventilation slots of the device, do not cover them with any kind of object.
6.- The space around the device must be free of objects, in a minimum radius of 40cm.
7.- Avoid locations with possibilities of spilling liquids on the inside of the device, and with important changes of temperature.
8.- Never open the device by yourself due to electric risk. In case of problems, go always to qualified technicians
9.- Never, under no circumstances, open the device when connected to the electrical net.
10.- During the handling it is better to disconnect the device from the electrical net.
11.- Obey the electricity security rules during the assembling. Use materials that obey the current law.
12.- The connecting plug must be accessible in a fast and simple way to have a fast disconnection.
13.- Never touch the plug with wet hands. Also, disconnect always the device before handling the connections.
14.- Never put any heavy object over the device, since it could get damaged.
15.- If the device is going to remain some time without use, it is recommendable to disconnect it from the electrical net.
16.- The repairmen and the maintenance of the device must be done by TV and radio specialised technicians.

1.2. Box content

Quick installation guide

Link F male – F male

DC Cable

ETWF 310

Cable 12 cm PIN to PIN RJ45 – RJ45

1.3. Description and connections

The module ETWF 310 is used for the reception of two base band channels (A/V).
Each module allows the modulation of both base band input signals in a multiplex DVB-T (COFDM).
A feature of this equipment is its modulator in Vestigial Side Band (or VSB). This modulation can be used to distribute adjacent channels in one distribution without any intermodulation problem.
Each module has one Loop connector to cascade several modules at input and a Mix connector to do same in output channels.The output channel is selectable between C2 and C69.
All parameters are programmed by the means of PRO 201 or the EVO or MINI series of field strength meter, and they are monitored in the display of programmer or in the 5" TFT screen of field strength meter.

ETWF 310

1. Two-colored led*: It indicates the different states of the device.
2. OUT: This connector supplies the modulated channel according to the selected standard in the module and mixes it with all the signals that it receives through the MIX connector
3. MIX: Input of mixing of the module.
4. L1/R1: RCA audio inputs (channel 1).
5. L2/R2: RCA audio inputs (channel 2).
6. RS 232: Ethernet connector to cascade modules with the RCM 310 telecontrol unit with the RJ45/RJ45 cable provided.
7. PRO 201: Ethernet connector to make the programming with the programmer.
8. Video 1/Video 2: RCA video inputs (channel 1 & 2).
9. DC connectors: It has two connectors for input/output.

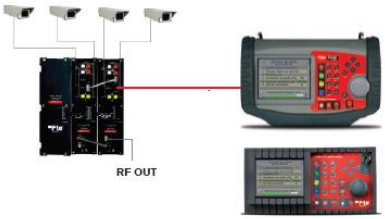
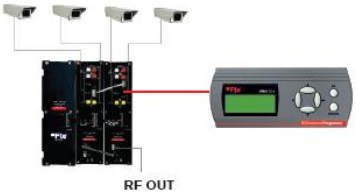
***States of two-colored leds**

1. Initialization mode
   - Green: main application charged.
   - Blinking Green: Completing the initial sequence, at the moment when the module gets initialized, the led will turn into one of the states the operating mode.
   - Red: Phase of initializing the module.
2. Operative Mode
   - Green: The system is working properly.
   - Orange: At least one critical event has been recorded in the module. The led will only change into green when the registration of events has been read by the programmer.
   - Red: Error or alert detected in the running of the device, the led will be on only as long as the error/alert is present. Once the error or the alert disappears, the led will change into orange because the error/alert is stored in the registration of events.
3. Programming mode
   - When the module detects an external programmer, the led will blink in the next sequence: green-orange-red.
   - Once you leave the programming mode, the led will turn into the corresponding operating mode.

1.4. Programming

ETWF 310 has two ethernet connectors. In order to make the programming of the module you have to connect the corresponding programmer to PRO 201 connector.
You can make the programming through the PRO 201 programmer and also through the mediaMAX EVO and mediaMAX MINI field strength meter.

1.4.1. Programming modes

	
With mediaMAX EVO / mediaMAX MINI field strength meter you can carry out the programming of all the modules consecutively as long as they are interconnected with each other through the RJ-45 cable supplied with each unit.	Through PRO 201, the programming is made module by module.

1.4.2. Programming

Below you will find the steps to follow in order to make the programming both from corresponding EVO and MINI field strength meter as well as from PRO 201.

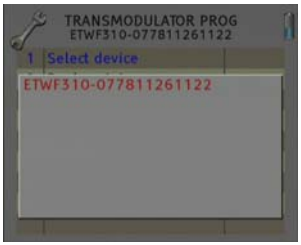
mediaMAX EVO / mediaMAX MINI

In order to start programming the ETWF 310 encoder, you will have to go to "Tools" option through the key 8 of your field strength meter and to select the "Transmodulator Prog." option.

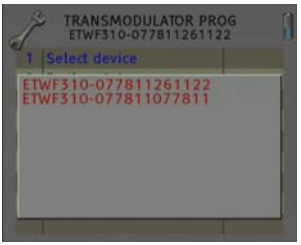
Then, it will proceed to recognize the module and to show the main menu. In the "Transmodulator Prog." are shown the different configuration options that this tool offers:

1. Select Device

The field strength meter allows carrying out the programming of one or several modules from an only modules.



Without interconnection of modules.
An only module connected

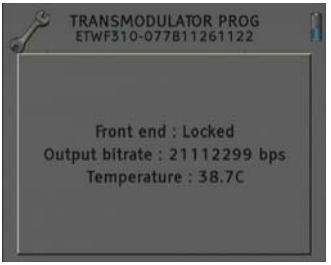


Interconnection of several modules, you can select which module you wish to program.

2. Device Status

In the option "Device Status" are specified the main parameters of the module at this moment.

- Front End: It indicates whether the module is hooked or without signal.
- Output bit rate: Transfer of data in the module output.
-Temperature: It indicates the current temperature of the module in ºC.

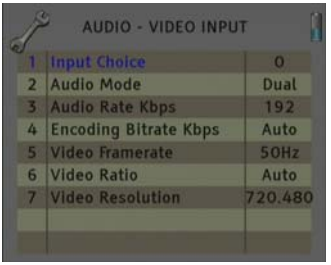


3. Set Front End

With this option you will be able to configure the input parameters of each one of the two A/V inputs:

- Input selecting: It allows selecting the input that will be configured. In order to configure input 1, please select 0 and if you want to configure input 2, please select 1. Once the input has been selected, the rest of the parameters of this menu will configure the selected input signal, with the exception of the parameters for "Video Resolution" and "Codification Rate", which are the same for both inputs.

- Audio mode: It allows selecting the audio mode of the output. Options: Stereo, J.Stereo, Dual and Mono.
- Audio rate: It allows selecting the audio rate in Kbits/s. Options: 64, 96, 160, 192, 256, 288, 320, 352, 384, 416 and 448.
- Coding rate: Coding rate of the output video. Options: Auto or 0-6750 Kbps.
- Video framerate: Number of images per second. Options: 50/60.
- Video Relation: Output Image Relation (appearance). Options: Auto, 1/1, 4/3, 16/9, 2.21/1.
- Video Resolution: Output Video Resolution. Options: 360x480, 352x240, 176x120, 480x480, 545x480, 720x480.

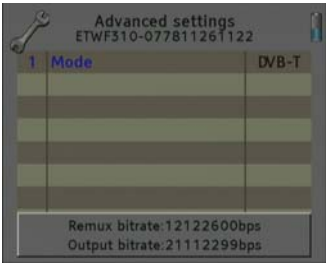

AUDIO - VIDEO INPUT
1 Input Choice 0
2 Audio Mode Dual
3 Audio Rate Kbps 192
4 Encoding Bitrate Kbps Auto
5 Video Framerate 50Hz
6 Video Ratio Auto
7 Video Resolution 720.480

4. Modulator Set Up

This option allows configuring the DVB-T/DVB-H modulator of the device.

- Bandwidth: Selection of the Bandwidth of the modulated signal: 8 MHz, 7 MHz, 6 MHz and 5MHz. The 5 MHz option is only supported by DVB-H standard.
- FFT Mode: 8K, 4K and 2k. The 4k option is only supported by DVB-H standard.
-Spectrum inversion: Activate or deactivate the spectrum reverse in the modulation.
- Guard interval: Allows selecting the guard interval of the modulation:1/4, 1/8, 1/16 and 1/32.
- FEC: Indicates the relationship between the redundant bits and the transmitted information bits:1/2, 2/3, 3/4, 5/6 y 7/8. For example, in a FEC = 2/3 relation we will find 2 information bits and 1 redundant bit.

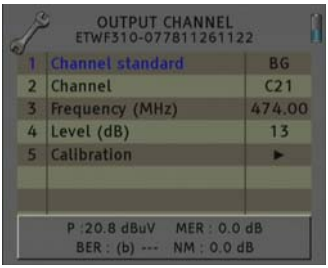
- Modulation: Output modulation format: 4 (QPSK), 16 (16 QAM), 64 (64 QAM).
- Advanced settings:
    - Mode: Selection of the modulation standard: DVB-T and DVB-H.



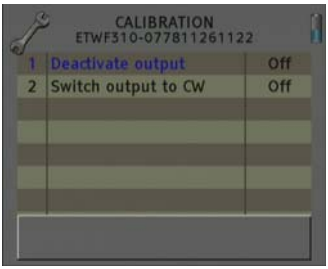
Note: The output useful bits rate will depends on the following parameters: Bandwidth, guard interval, FEC codification and modulation. In the *Attachment I* you will find all the information related to the resulting useful bit rate in each configuration.

5. Set Output channel

In this option you can configure the different parameters of the cable signal.


OUTPUT CHANNEL
ETWF310-077811261122
1 Channel standard BG
2 Channel C21
3 Frequency (MHz) 474.00
4 Level (dB) 13
5 Calibration ▶
P :20.8 dBuV MER : 0.0 dB
BER : (b) --- NM : 0.0 dB

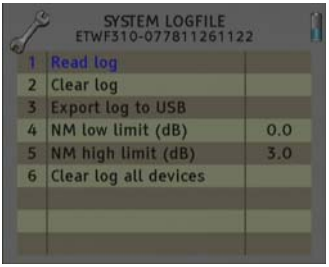
- Channel standard: It allows you to select the channelling of the cable signal standards. Options: BG, BG, PAL BG IT, 11, M NTSC, PAL M, PAL N, PAL DK , PAL I, BB_AU, DK PAL, L PAL.
- Channel: Output channel of the cable modulation. When you select the output channel, the field "Frequency (MHz)" will be modified automatically, adapting itself to the selected channel. Options: C2-C69.
- Frequency (MHz): Output frequency of cable modulation. When you modify this field, the field "Channel" will be also modified, indicating the channel equivalent to the selected frequency in the case that this frequency corresponds to the frequency of a channel. Options: 47-862 MHz.
- Level: Regulation of the output level of the modulated signal. Options: 0-15dB.
- Calibration: Allows the realization of two tests in order to verify the correct running of the device.
    - Deactivate output: It allows activating or deactivating the ouput of module.
    - Switch output to CW: It allows activating or deactivating the DVB-T / DVB-H modulation, allowing visualizing the carrier without modulation in the selected frequency.



6. System

This option provides information of the module.

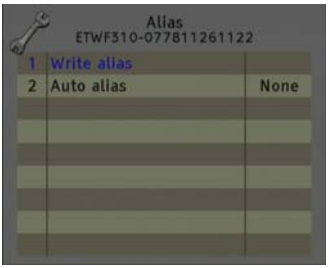
- System logfile: In this field are indicated the registered events in the module.
  - Read log: It allows reading the registered events in the module.
  - Clear log: It allows deleting all events stored until this moment.
  - Export log to USB: It allows you to export all events registered to the connected USB device.
  - NM low Limit (dB): An event of error will be recorded when the value of Noise Margin is lower than the set value.
  - NM hight limit (dB): Once the event of error is recorded (Noise Margin < Limit Lower NM), this will be Noise Margin value that will have to be exceed so the module stops being in error.
  - Clear log all devices. It allows deleting the events report of all the interconnected modules.
- Factory default: This option restores the values by default of the module.
- System information: It allows you to visualize the basic information of the module: model, no of series, firmware version, etc.



- Settings: This option allows saving and loading the configuration of the module, carrying out firmware update or making an adjustment of the time and date of the module.

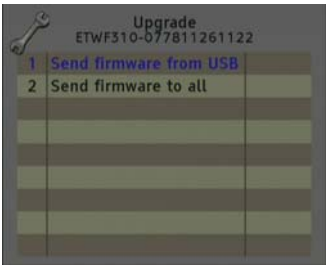
  - Clock:
    - Set Date and time: Setting of the date and time of module. It is appropriate to maintain these parameters set in order to have the registration of errors linked to the current time and date.
    - Set date/time all devices: Loading the current date and time of the module in the rest of interconnected modules.

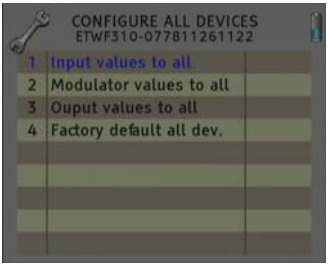
  - Alias:
    - Write alias: It allows you to assign a name/alias to the module you are programming. Option only available when the Alias Auto option is configures as "none" (manual mode).
    - Auto Alias: It allows configuring the name/alias of the modules automatically. Options: Channel, Frequency, Service, None.



  - Upgrade:
    - Send Firmware from USB: It allows carrying out the firmware update from the USB device.
    - Send firmware to all: It allows carrying out the update of all the modules that are interconnected at the same time.

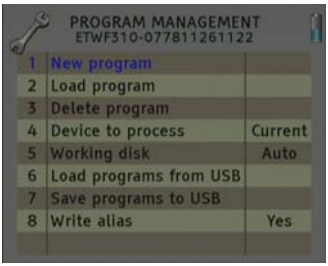
- Configure all devices:
  - Input values to all devices: It allows copying the current input configuration in all the interconnected modules.
  - Modulator values to all devices: It allows copying the configuration of the current modulator in all the interconnected modules.
  - Output values to all devices: It allows copying the current output configuration in all the interconnected modules.
  - Factory default to all devices: It allows making values by default to all the interconnected modules.




CONFIGURE ALL DEVICES
ETWF310-077811261122
1 Input values to all
2 Modulator values to all
3 Ouput values to all
4 Factory default all dev.

7. Program management

- New program: This option allows creating a program with the current configuration of a module or group of modules.
- Load program: It allows loading a previously created program on a module or group of modules.
- Delete program: It allows deleting a program.
- Device to process:
  - Current: The creation or loading of a program will be applied only in the module that is currently connected.
  - All: The creation or loading of a program will be applied to the whole group of connected modules.
- Working disk: With this option we have the possibility of choosing if we want to work into the internal disk or in the external storage device USB 2.0.

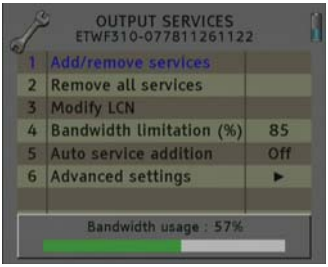


Once the option is selected, a dialog box will appear and we will be able to choose among three different options:
  - Auto: The Meter decides where the data will be stored. If there is external memory connected, the Meter will store the data in it. If not, it will use the internal memory.
  - USB: The Meter always will try to use the external memory connected to the USB port. If this memory has not been connected an error message will be shown, reminding that there was an error storing the data and it will be not stored.
  - Internal: Always the internal memory is used to store the data.
- Load programs from USB: This option allows importing programs from a USB memory to the field strength meter. Before using this option you must connect a USB memory.
- Save programs to USB: This option allows copying the programs stored in the external USB 2.0 storage device.
- Write Alias: It allows saving the alias of the module in the program. Options: Yes/No

8. Set Output Services

This option allows making the selection of the services that you wish to include in the output multiplex.

- Add/Remove services: It allows adding the services to the multiplex and also removing the ones previously included. The lower bar informs about the available space in the output multiplex. As you add more services, the space available will decrease.



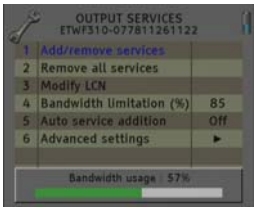
Adding services:

1. Select "Service to add" option

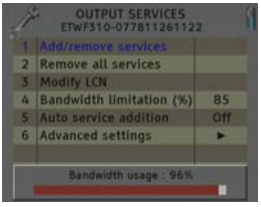
2. Select one of the transponder services you want to add.

3. Once you have chosen the service, select the "Add/Remove" button to include the service in the multiplex.

Note: It is not recommended to exceed the 85% of the maximum capacity of the multiplex due to the possible variability of the bits rate of the inputs services.



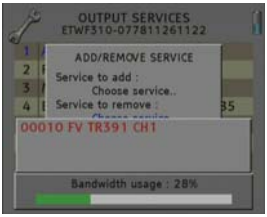
Recomendad capacity
(lower to 85%)



Excessive capacity
It is recommended to remove services

Removing services:

1. Select the "Service to remove" option.



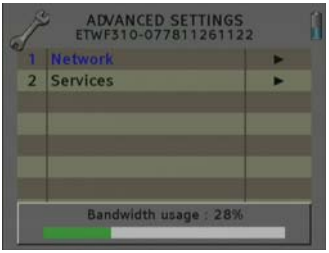
2. Select one of the transponder services you want to remove.

3. Once you have chosen the service, select the "Add/Remove" button to remove the service in the multiplex.

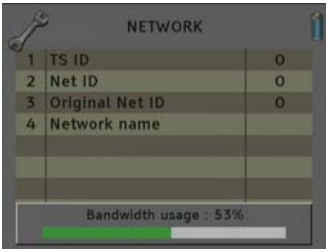
- Remove all services: It allows removing all the services included in the multiplex.
- Modify LCN: The LNC function allows assigning automatically a predetermined position to each one of the services of the multiplex. This function will allow the users who have a receiver with LNC support to make the ordination of channels automatically.

Note: If in the existing installation there are already services that have LNC system, you will have to configure the position of the module services in order to avoid conflicts with other net services.

- Bandwidth limitation: It allows selecting the % of the capacity of the output channel.
- Auto service addition:
  - On: It selects the services automatically when an input carrier is tuned and when the list of selected services is empty. The receiver will have this state by default.
  - Always: It selects the services automatically every time a new input carrier is tuned. This state is only recommended to be used for making test in the module.
  - Off: The automatic mode is deactivated; the services have to be manually selected.



- Advanced settings:
  - Network: It allows making the adjustment of the identification parameters of the multiplex.
    - TS ID: Transport Stream identification value. It is recommended to configure a value different from TS ID for each one of the output multiplex configured.
    - Net ID: Net identification value
    - Original Net ID: Original net identification value
    - Network Name: Name associated with the net.



  - Services:
    - Change service name: It allows changing the name of the service manually. In order to do so, please choose the service in the first line and then write the new name in the second line. Then you have to press "modify" in order to save the changes.

Next it is attached the identification table (NID/ONID) of the main satellites. You will be able to find more information in the law ETSI TR 101 162 v1.2.1.

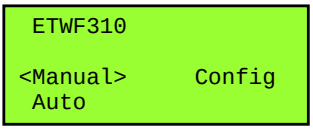
Satellite	Net ID	Original Net ID	Description
Hotbird 13ºE (Eutelsat 13ºE)	318	318	Eutelsat 13ºE System
Astra 19.2ºE	1	1	Astra Satellite Network 19,2ºE
Astra 23ºE	3-25	3-25	Astra n (n=1-23)
Astra 28,2ºE	2	2	Astra Satellite Network 28,2ºE
Nilesat 7ºW	2048	2048	Nilesat 101
Hispasat 30ºW	33	33	Hispasat Network 1

PRO 201

Note: From PRO 201 programmer you can only carry out the programming of a single module, in order to carry out the programming of several modules at the same time you have to use a mediaMAX EVO or mediaMAX MINI series field strength meter.

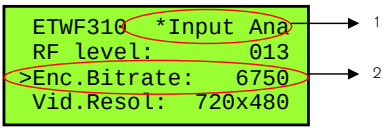
When you connect the PRO 201 programmer, it will proceed to recognize the module and to show the main menu.
In the main menu are shown the different options for configuring the module.

We have to use the "Up" and "Down" buttons of the keyboard in order to move to the different options, and to get into the submenus we have to press "OK" button.



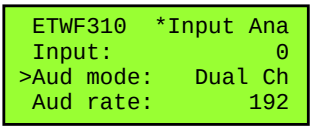
1. Manual

Inside the "manual" menu there are specified the different options for setting up the input, output and modulation parameters.
1. This field shows the type of parameter that is selected at the moment. Options: Input Sat, Out Terr, Out TV.
2. This field shows the parameter that is selected. In order to move around the different options we have to use the "Up" and "Down" buttons of the keyboard.. Click on OK to edit the selected parameter and Right/Left for changing it. Once it is configured press OK.



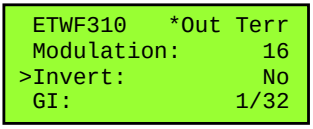
Satellite input (Input Sat)

I With this option you will be able to configure the input parameters of each one of the two A/V inputs:



- Coding rate: Coding rate of the output video. Options: Auto or 0-6750 Kbps.
- Video Resolution: Output Video Resolution. Options: 360x480, 352x240, 176x120, 480x480, 545x480, 720x480.
- Input selecting: It allows selecting the input that will be configured. In order to configure input 1, please select 0 and if you want to configure input 2, please select 1. Once the input has been selected, the rest of the parameters of this menu will configure the selected input signal, with the exception of the parameters for "Video Resolution" and "Codification Rate", which are the same for both inputs.
- Audio mode: It allows selecting the audio mode of the output. Options: Stereo, J.Stereo, Dual and Mono.
- Audio rate: It allows selecting the audio rate in Kbits/s. Options: 64, 96, 160, 192, 256, 288, 320, 352, 384, 416 and 448.
- Video framerate: Number of images per second. Options: 50/60.
- Video Relation: Output Image Relation (appearance). Options: Auto, 1/1, 4/3, 16/9, 2.21/1.

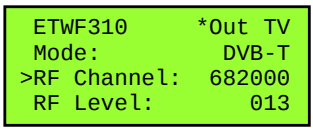
Terrestrial modulation (Out Terr)
These options allow configuring the DVB-T/DVB-H modulator of the device.



- Modulation: Output modulation format: QPSK (4 QAM), 16 QAM, 64 QAM.
- Invert (Spectrum inversion): Activate or deactivate the spectrum reverse in the modulation.
- GI (Guard interval): Allows selecting the guard interval of the modulation: 1/4, 1/8, 1/16 and 1/32.
- BW (Bandwidth): Selection of the Bandwidth of the modulated signal: 8 MHz, 7 MHz and 6 MHz and 5MHz. The 5 MHz option is only supported by DVB-H standard.
- Tx Mode (FFT Mode): 8K, 4K and 2k. The 4k option is only supported by DVB-H standard.
- FEC: Indicates the relationship between the redundant bits and the transmitted information bits:1/2, 2/3, 3/4, 5/6 y 7/8. For example, in a FEC = 2/3 relation we will find 2 information bits and 1 redundant bit.
- Mode: Selection of the modulation standard: DVB-T and DVB-H.

Note: The output useful bits rate will depend on the following parameters: Bandwidth, guard interval, FEC codification and modulation. In the *Attachment I* you will find all the information related to the resulting useful bit rate in each configuration.

Output configuration (TV output)
In these options you can configure the output parameters of the terrestrial signal.

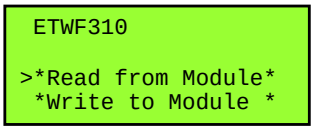


- RF Channel (MHz): Output frequency of terrestrial modulation. In order to introduce the frequency, press the "OK" button and the cursor will be placed over the frequency. With the keys of the cursor, we can move through all the digits and change the values. Press "OK" in order to save the value. Options: 47-862 MHz.
- RF Level: Regulation of the output level of the modulated signal. Options: 0-15dB.

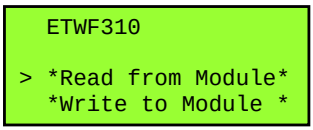
Summary table:

Analogue input	Terrestrial output	TV output
- Coding rate	- Modulation	- RF Channel
- Video Resolution	- Invert (Spectrum Inversion)	- RF Level
- Input selecting	- Guard Interval (GI)	
- Audio mode	- Bandwith (BW)	
- Audio rate	- Tx Mode (FFT Mode)	
- Video framerate	- FEC	
- Video Relation	- Mode	

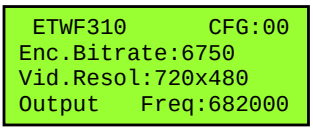
2. Auto
This option allows saving and loading the configuration of the module in the PRO 201 programmer.



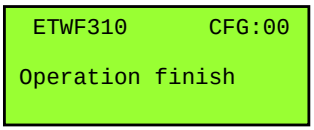
- Read from module: It stores the current configuration of the module in the memory of the programmer. The steps to make a correct reading of the headend are specified below:



1. Select the option "Read from module" through Up/Down buttons. Press OK to continue

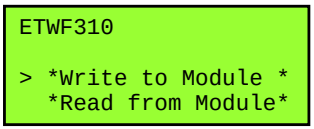


2. Select the position of "CFG" memory where you wish to save the current configuration of the module.

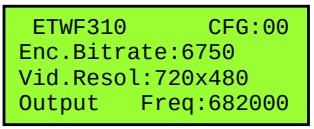


3. A window will appear and it will let you know that the reading made has been correct

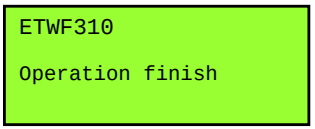
- Write to module: It loads in the module one of the configurations previously saved in the memory of the programmer. The steps to make a correct configuration of the headend are specified below:



1. Select the option "Write to module" through Up/Down buttons. Press OK to continue



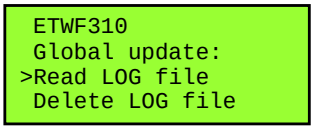
2. Select the position of the "CFG" memory that you wish to copy in the module. Please verify that the data of the selected memory correspond to the channel that you wish to copy.

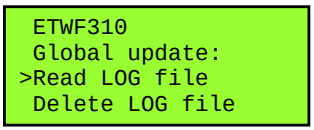


3. A window will appear and it will let you know that the configuration made has been correct

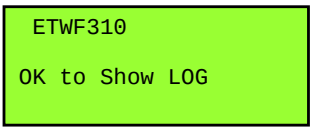
3. Config
In "Config" option the information concerning the module is given.

- Read log: It allows reading the registered events in the module.

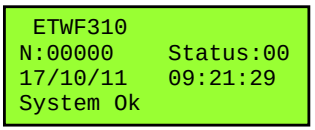




1. Select the option "Read LOG file" through Up/Down buttons. Press OK to continue



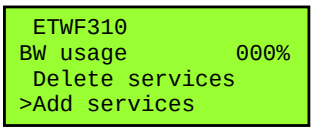
2. Press OK again to show the log file.



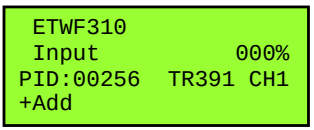
3. A new window will appear. It will show the information about the registered events in the module. Press the following keys in order to scroll up and down the screen: "up/down".

- Delete LOG file: It allows deleting all events stored until this moment.
- Factory default: This option restores the values by default of the modules.
- Update FW: It allows carrying out the firmware update from the programmer.
- Output services: This option allows making the selection of the services that you wish to include in the output multiplex. Once you have tuned a transponder and you have selected the DVB-T/DVB-H modulator configuration, you can make the assignment of the services that are going to be included in the output multiplex "Adding/Removing services".

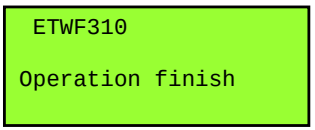
- Add Services



1. Select the option "Add services" through Up/Down buttons. Press OK to continue.

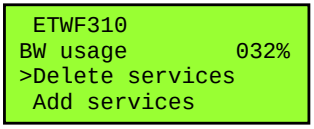


2. Select one of the transponder services you want to add, through Left/Right keys and select the "+Add" button to include the service in the multiplex

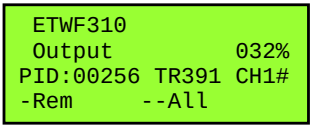


3. A window will appear and it will let you know that the operation made has been correct.

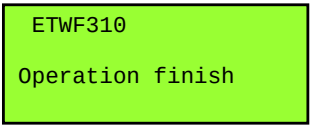
- Delete Services



1. Select the option "Delete services" through Up/Down buttons. Press OK to continue.



2. Select the service you want to delete with the Left/Right keys. Then press OK over "-Rem" in order to remove it, or press OK over "--All" in order to delete all the services of the multiplex.



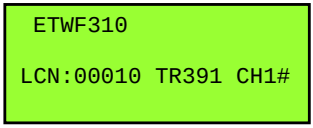
3. A window will appear and it will let you know that the operation made has been correct.

Note: It is not recommended to exceed the 85% of the maximum capacity of the multiplex due to the possible variability of the bits rate of the inputs services.

- Change service name: It allows changing the name of the service manually.
- Date / Hour: Setting of the date and time of module. It is appropriate to maintain these parameters set in order to have the registration of errors linked to the current time and date.
- SW version info: It allows you to visualize the basic information of the module: model, firmware version, etc.
- Global Update: It allows carrying out the update of all the modules that are interconnected at the same time.
- TSID: Transport Stream identification value.

Note: It is recommended to configure a value different from TS ID for each one of the output multiplex configured.

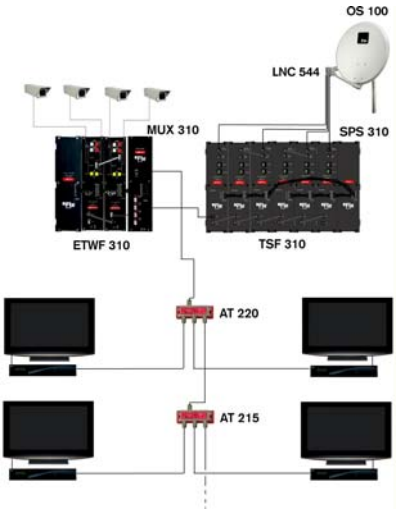
- NID: Net identification value
- ONID: Original net identification value
- Network Name: Name associated with the net.
- LCN: The LNC function allows assigning automatically a predetermined position to each one of the services of the multiplex. This function will allow the users who have a receiver with LNC support to make the ordination of channels automatically.
Select a channel through Left/Right buttons and introduce the position. Press the "OK" button and the cursor will be placed over the number. With the keys of the cursor, we can move through all the digits and change the values. Press "OK" in order to save the changes



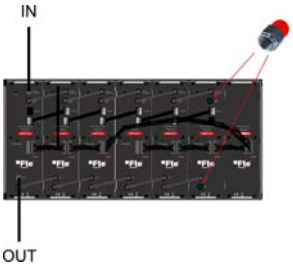
Note: If in the existing installation there are already services that have LNC system, you will have to configure the position of the module services in order to avoid conflicts with other net services.

1.5. Accessories and example of installation

Example of installation



The installation is formed by 6 TSF 310 and two ETWF 310 that will make possible to tune up to 6 different transponders (TSF) and moreover the reception of up to 4 base band channels (ETWF 310). In both cases the channels will be modulated in DVB-T and distributed through the installation.
The distributed channels will need a terrestrial digital receiver in order to get decoded, in this case we recommend a MAX T 115 HD receiver that will decode the transmitted free channels.



Note: In order to guarantee the right running of the different equipments of the installation, we recommend you to provide the inputs and outputs which are not used with a 75Ω load.

Accessories

Programmer
Mod. PRO 201
Code 2003123

Field strength meter
Mod.MediaMAX EVO S2
Code 3001006

Field strength meter
Mod. MediaMAX MINI S2T
Code 3001026

Wide band amplifier 47-862MHz
Mod. AMP 310 P
Code 2003520

Mixer
Mod. MUX 310
Code 2003518

Chapter 2. Technical features

Ref.	ETWF 310
Code	2003566
Description	2 x A/V Stereo --> 1x COFDM
Input system TV	CVBS Base band
Imput video level (Vpp)	1
Video impedance	75 Ohms
Imput audio level (Vpp)	0.6
Audio impedance	75 Ohms
Coding rate (kbits / s)	500 - 6750
Video relation	Auto, 1/1, 4/3, 16/9, 2.21/1
Video resolution	720x480, 360x480, 352x240, 176x128, 480x480, 544x480.
Selectable format of output modulation	DVB-T / DVB-H
Bandwidth (MHz)	DVB-T: 6/7/8 - DVB-H: 5/6/7/8
Mode	DVB-T: 2k-8k - DVB-H: 2k-4k-8k
Output channels	C2-C69
Output connectors	F female
Output Level	80 dBuV
Regulation margin	15 dB
MIX Losses	<1 dB
Band spurious	-60 dBc
Programming Interface	RJ-45
Programmer	PRO 201, media Max EVO and media Max MINI
Operating temperature	0ºC-45ºC
Consumption 5V (mA)	1330
Consumption 12V (mA)	300
Consumption 24V (mA)	0
Consumption 30V (mA)	0.5
Dimensions	75x265x150 mm
Weight	1,4Kg

Chapter 3. Declaration of conformity

CONFORMITY DECLARATION

"WE , FTE MAXIMAL, DECLARE THAT THE PRODUCT
ETWF 310
IS IN CONFORMITY WITH FOLLOWING DIRECTIVES
Low Voltage Directive 2006/95/EC
EMC Directive 2004/108/EC"

If you wish a copy of the conformity declaration, please contact to the company

ATACHMENT I

Depending on the configured parameters we are going to obtain one particular channel capacity (output useful bit rate). In order to make an estimation of this output bits rate, we have to take into account the following parameters:

Symbol duration (Ts)

For signals of 8 MHz

Mode	8K (6817 carrier)				4K (3409 carrier)				2K (1705 carrier)			
Symbol duration	896 us				448 us				224 us			
Guard Interval	1/4	1/8	1/4	1/8	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32
Duration	224us	112us	56us	28us	112us	56us	28us	14us	56us	28us	14us	7us

For signals of 7 MHz

Mode	8K (6817 carrier)				4K (3409 carrier)				2K (1705 carrier)			
Symbol duration	1024 us				512 us				256 us			
Guard Interval	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32
Duration	256us	128us	64us	32us	128us	64us	32us	16us	64us	32us	16us	8us

For signals of 6 MHz

Mode	8K (6817 carrier)				4K (3409 carrier)				2K (1705 carrier)			
Symbol duration	1194,6 us				597.3 us				298,6 us			
Guard Interval	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32
Duration	298,7us	149,3us	74,7us	37,3us	149,3us	74,6us	37,3us	18,6us	74,6us	37,3us	18,6us	9,3us

For signals of 5 MHz

Modo	8K (6817 carrier)				4K (3409 carrier)				2K (1705 carrier)			
Symbol duration	1433,6 us				597.3 us				298,6 us			
Guard Interval	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32	1/4	1/8	1/16	1/32
Duration	358,4us	179,2us	89,6us	44,8us	179,2us	89,6us	44,8us	22,4us	89,6us	44,8us	22,4us	11,2us

Modulation

Modulation	QPSK	16 QAM	64 QAM
Number of bits per symbol	2	4	6

FFT Mode

FFT Mode	8K	4K	2K
Data carriers	6048	3024	1512
Total carriers	6817	3409	1705

Bits rate calculation (total)

$$Tb_{total} = fs \cdot b \cdot L$$

Where:
Fs = Symbols frequency (symbols/sec) fs=1/Ts
Ts = Symbol duration (Symbol Time + Guard Interval time)
b = Number of bits per symbol (depending on the modulation)
L = Number of data carriers (depending of FFT mode)

Bits rate calculation (useful)

$$Tb_{util} = Tb_{total} \cdot Codif_{\cdot FEC} \cdot Codif_{\text{Reed}-Salomon}$$

FEC Cod. = FEC Codification (1/2, 2/3, 3/4, 5/6, 7/8)
Reed-Salomon Cod. = Codification made by the means of Reed Salomón algorithym (188/204)

Case study example

For example, in the case of a DVB-T transmission in Spain the configured parameters would be the following: 8k mode, 2/3 FEC, ¼ guard intervals, 64QAM constellation, for an 8 MHz channel and using the previous formula you will get the following channel useful capacity:

$$Tb_{útil} = 19.905 Mbps$$

Note: As you select a configuration with a higher output channel capacity, the protection grade against mistakes gets proportionally decreased.

Next it is shown the channel capacity for systems without hierarchy in all the cases of constellation, guard interval and codification relation, for transmissions of 8MHz, 7MHz, 6MHz y 5MHz(DVB-H).
The useful capacity channel is identical for modes 2k, 4k(DVB-H) and 8k.

Useful channel capacity (8 MHz)

Modulation	FEC codification	Guad Interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	4.976	5.529	5.855	6.032
	2/3	6.635	7.373	7.806	8.043
	3/4	7.465	8.294	8.782	9.048
	5/6	8.294	9.216	9.758	10.053
	7/8	8.709	9.676	10.246	10.556
16-QAM	1/2	9.953	11.059	11.709	12.064
	2/3	13.271	14.745	15.612	16.086
	3/4	14.929	16.588	17.564	18.096
	5/6	16.588	18.431	19.516	20.107
	7/8	17.418	19.353	20.491	21.112
64-QAM	1/2	14.929	16.588	17.564	18.096
	2/3	19.906	22.118	23.419	24.128
	3/4	22.394	24.882	26.346	27.144
	5/6	24.882	27.647	29.273	30.16
	7/8	26.126	29.029	30.737	31.668

Useful channel capacity (7 MHz)

Modulation	FEC codification	Guad Interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	4.354	4.838	5.123	5.278
	2/3	5.806	6.451	6.83	7.037
	3/4	6.532	7.257	7.684	7.917
	5/6	7.257	8.064	8.538	8.797
	7/8	7.62	8.467	8.965	9.237
16-QAM	1/2	8.709	9.676	10.246	10.556
	2/3	11.612	12.902	13.661	14.075
	3/4	13.063	14.515	15.369	15.834
	5/6	14.515	16.127	17.076	17.594
	7/8	15.24	16.934	17.93	18.473
64-QAM	1/2	13.063	14.515	15.369	15.834
	2/3	17.418	19.353	20.491	21.112
	3/4	19.595	21.772	23.053	23.751
	5/6	21.772	24.191	25.614	26.39
	7/8	22.861	25.401	26.895	27.71

Useful channel capacity (6 MHz)

Modulation	FEC codification	Guad Interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	3.732	4.147	4.391	4.524
	2/3	4.976	5.529	5.855	6.032
	3/4	5.599	6.221	6.587	6.786
	5/6	6.221	6.912	7.318	7.54
	7/8	6.532	7.257	7.684	7.917
16-QAM	1/2	7.465	8.294	8.782	9.048
	2/3	9.953	11.059	11.709	12.064
	3/4	11.197	12.441	13.173	13.572
	5/6	12.441	13.824	14.637	15.08
	7/8	13.063	14.515	15.369	15.834
64-QAM	1/2	11.197	12.441	13.173	13.572
	2/3	14.929	16.588	17.564	18.096
	3/4	16.796	18.662	19.76	20.358
	5/6	18.662	20.735	21.955	22.62
	7/8	19.595	21.772	23.053	23.751

Useful channel capacity (5 MHz)

Modulation	Codificación FEC	Guad Interval			
		1/4	1/8	1/16	1/32
QPSK	1/2	3.110	3.456	3.659	3.770
	2/3	4.147	4.608	4.879	5.027
	3/4	4.665	5.184	5.489	5.655
	5/6	5.184	5.760	6.099	6.283
	7/8	5.443	6.048	6.404	6.598
16-QAM	1/2	6.221	6.912	7.318	7.540
	2/3	8.294	9.216	9.758	10.053
	3/4	9.331	10.368	10.978	11.310
	5/6	10.368	11.520	12.197	12.567
	7/8	10.886	12.096	12.807	13.195
64-QAM	1/2	9.331	10.368	10.978	11.310
	2/3	12.441	13.824	14.637	15.080
	3/4	13.996	15.551	16.466	16.965
	5/6	15.551	17.279	18.296	18.850
	7/8	16.329	18.143	19.211	19.793

Note: Only aplicable for DVB-H.

ESPAÑA
Mogoda, 110
Pol. Industrial Can Salvatella
08210 Barberà del Vallès
(Barcelona) España
Tel. 00 34 93 729 27 00
Fax. 00 34 93 729 30 73
ftemaximal@ftemaximal.com
www.ftemaximal.com

FRANCE
16 ZAE Les Mouilles
74570 Groisy
Tel. 00 33 450 68 80 17
Fax. 00 33 450 68 84 68
sav@ftemaximal.fr
www.ftemaximal.com

ITALIA
Via Edison, 29
42040 Calerno di
Sant'Ilario d'Enza (RE)
Tel. 00 39 05 22 90 97 01
Fax. 00 39 05 22 90 97 48
fte@fte.it
www.ftemaximal.com

DEUTSCHLAND
Auf der Höhe, 8
44536 Lünen
Deutschland
Tel. 00 49 (0) 23 18 78 5 - 01
Fax. 00 49 (0) 23 18 78 5 - 200
info@ftemaximal.de
www.ftemaximal.de

PORTUGAL
Rua José Carlos Ary dos Santos
A-das-Lebres (Loures)
2670-791 Santo Antão do Tojal
Tel. 00 351 219 83 87 00
Fax. 00 351 219 83 87 09
ftemaximal@ftemaximal.pt
www.ftemaximal.com

UNITED ARAB EMIRATES
P.O.Box 262442
Jebel Ali Free Zone
Warehouse FZS5AB03
Dubai
Tel. 00 971 4 886 5700
Fax. 00 971 4 886 5701
www.ftemaximal.ae